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IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE

Patent Application

Inventors(s):	Susanne Arney Timofei Nikita Kroupenkine Donald Weiss	**Case:**	10-18-4
Serial No.:	10/798,064	**Filing Date:**	March 11, 2004
Examiner:	Brian E. Pellegrino	**Group Art Unit:**	3738
Title:	Drug Delivery Stent		

THE COMMISSIONER OF PATENTS AND TRADEMARKS
ALEXANDRIA, VA 22313-1450

SIR:

RESPONSE TO NOTIFICATION OF NON-COMPLIANT APPEAL BRIEF

In response to the Notification of Non-compliant Appeal Brief of March 27, 2009, enclosed in triplicate is a revised **Appeal Brief** in the above-identified patent application.

No additional fee is required.

In the event of non-payment or improper payment of a required fee, the Assistant Commissioner is authorized to charge or to credit my **VISA** as required to correct the error. Form 2038 is not attached but will be provided if necessary.

Respectfully,

By_____

Michael J. Urbano
Attorney for Applicant(s)
Reg. No. 24522
610-691-7710

Date: 04/24/09

Express Mail No. EL 989175067 US

Date of Deposit 04/27/09

I hereby certify that this application is being deposited with the U.S. Postal Service "Express Mail Post Office to Addressee" service under 37CFR1.10 on the date indicated above and is addressed to the Commissioner for Patents, PO Box 1450, Alexandria, VA 22313-1450

Michael J. Urbano:

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SIR:

APPEAL BRIEF UNDER 37 CFR § 41.37

I. Real Party In Interest

The real party in interest is Alcatel-Lucent USA Inc., 600-700 Mountain Avenue, PO Box 636, Murray Hill, NJ, 07974-0636.

II. Related Appeals and Interferences

There are no related appeals or interferences.

III. Status of the Claims

Claims 1-21 are on appeal.

Claims 22-28 have been canceled pursuant to a restriction requirement.

IV. Status of Amendments

No amendment was filed subsequent to the final Office action of October 15, 2008.

V. Summary of Claimed Subject Matter

Applicants' invention on appeal relates to unique stents configured to provide dynamic control of the hydrophobicity of a microstructured surface of the stent that contacts body fluid. Examples of these stents are described in the specification from page 4, line 18 to page 12, line 7.

As set forth in independent claim 1, an implantable stent (e.g., element 60; FIG. 5) comprises a tubular member having an interior surface and an exterior surface, with a region of at least one of the surfaces being hydrophobic to a body fluid (e.g., layer 67; FIG. 3); the contact angle between a droplet of the body fluid (e.g., 40; FIG. 3) and the surface is greater than 90° (see, e.g., specification, page 7, lines 3-4). The hydrophobic surface region is provided with an array (e.g., element 62; FIGs. 3, 5) of microstructures or nanostructures (see, e.g., specification; page 4, lines 19-29) that covers first portions of the surface. The array causes the region to have a dynamically controllable hydrophobicity (e.g., page 5, lines 23-28; FIG. 3).

As set forth in independent claim 18, an implantable stent (e.g., element 60; FIG. 5) comprises a tubular member including a conducting substrate (element 63; FIGs. 3, 5) and having an interior surface and an exterior surface, with a region of at least one of the surfaces being hydrophobic to a body fluid (e.g., layer 67; FIG. 3); the contact angle between a droplet of the body fluid (e.g., 40; FIG. 3) and the surface is greater than 90° (see, e.g., specification, page 7, lines 3-4). The hydrophobic surface region is provided with an array (e.g., element 62; FIGs. 3, 5) of pillar-like microstructures or nanostructures (see, e.g., specification; page 4, lines 19-29) that covers first portions of the surface. The array causes the region to have a dynamically controllable hydrophobicity (e.g., page 5, lines 23-28; FIG. 3) between a first state, in which the body fluid 40 is suspended over the top of the microstructures or nanostructures (e.g., fluid 40; FIG. 3), and a second state, in which the fluid penetrates the interstices of the microstructures or nanostructures (e.g., akin to fluid 10; FIG. 2). A medicinal substance (e.g., element 69; FIG. 3) is adhered to a second portion of the hydrophobic surface located in the interstices, and a control device (e.g., element 72, FIG. 6; element 82, FIG. 7) is affixed to the tubular member for applying voltage between the fluid and the substrate to vary the hydrophobicity, thereby releasing the medicinal substance into the body fluid when in the second state. The control device is

actuatable from an *ex vivo* source (e.g., element 74, FIG. 6; element 84, FIG. 7).

VI. Grounds of Rejection To Be Reviewed

A. Whether claims 1-21 are anticipated by or, in the alternative, obvious over Bailey, Momma, Shastri, Oktay, or Bailey in view of Momma, as applied by the Examiner.

B. Whether claim 18 contains additional features that render it patentable over the art of record, Bailey in particular, as applied by the Examiner.

VII. Argument

A. Claims 1-21 are neither anticipated by nor obvious over Bailey, Momma, Shastri, and Oktay, as applied by the Examiner, because the Examiner does not cite a prior art teaching for each element in these claims.

All of the prior-art-based claim rejections have at least one fundamental and common deficiency. The rejections do not provide any prior art teaching for:

> one of said surfaces being ... in that the contact angle between a droplet of said [body] fluid and said at least one surface is greater than 90°, ... (emphasis added)

as recited for the implantable stent of pending independent claims 1 and 18. With respect to all four prior art references [Bailey, Momma, Shastri and Oktay], the Examiner explicitly acknowledges this deficiency by stating that each reference "does not explicitly state the surface has a contact angle greater than 90° when any drop of fluid contacts it." [Final Office Action of October 15, 2008, p. 4, lines 20-22 (Bailey); p. 6, lines 1-2 (Momma); p. 7, lines 2-3 (Shastri); p. 8, lines 3-4 (Oktay)]

The Examiner attempts to circumvent the above-discussed fundamental deficiency of the art rejections by stating that the "contact angle" limitation of pending claims 1 and 18 is product-by-process language. [Final Office Action, October 15, 2008; p.4, lines 21 *et seq.* (Bailey); p.6, lines 3-4 (Momma); p. 7, lines 4-5 (Shastri); and p.8, lines 4-6 (Oktay)] According to I. H. Donner, *Patent Prosecution, Practice & Procedure Before the U.S. Patent Office*, 3rd Ed., BNA, Washington, D.C. (2003), p. 1147, product-by-process claim language "define[s] a composition

of matter or article in terms of how the article is made, rather than in terms of the structure of the article." [emphasis added] Nothing in the above recitation of pending claims 1 and 18 describes how elements therein are made. For that reason, this recitation of pending claims 1 and 18 is not product-by-process language. Instead, the above recitation from pending claims 1 and 18 defines one of the surfaces therein by its function or action on a droplet of body fluid. That is, rather than being product-by-process language, this recitation of pending claims 1 and 18 is a functional feature.

In particular, the above recitation of pending claims 1 and 18 limits the form of one surface of the stents of these claims by its function or action on a droplet of a body fluid. The surface causes such a droplet of body fluid to make a contact angle therewith of greater than 90°. Such functional limitations are acceptable and must be considered by an Examiner when determining the patentability of a claim. Indeed, MPEP 2173.05(g) states:

> A functional limitation is an attempt to define something by what it does, rather than what it is...
> A functional limitation must be evaluated and considered, just like any other limitation of the claim...(emphasis added)

Thus, the above-discussed recitations of pending claims 1 and 18 must be given patentable weight as functional features.

Instead of citing a prior art teaching of the above functional features related to contact angles, the Examiner states that the prior art teaches metal stents that don't absorb water and are fully capable of having a contact angle greater than 90° when a droplet of body fluid contacts them. [Final Office Action, October 15, 2008; p. 4, lines 2-4 (Bailey); p. 5, lines 19-22 (Momma); p. 7, lines 20 *et seq.* (Oktay)] The Examiner provides no evidence that metal surfaces in prior art stents are configured to cause the contact angle between a body fluid and a surface of the stents to be greater than 90° as in pending claims 1 and 18. Applicants have not waived their right to have the Examiner present evidence to support such a conclusion on the record, and the Examiner has not presented evidence of such a feature in metal stents.

In contrast, Applicants have provided expert evidence of Dr. T. N. Kroupenkine that the

surfaces of metals do not inherently satisfy the above-discussed "contact angle" recitation of pending claims 1 and 18. [Declaration under Rule 132 of Dr. T. N. Kroupenkine, July 29, 2008; hereinafter, the DECLARATION.]. For example, at paragraphs 5 and 9, the DECLARATION states that contact angles of body fluids with illustrative clean metal surfaces are less than 90°, e.g., contact angles for gold (Au), platinum (Pt), and stainless steel surfaces are about 71°, 0°, and 5° or less. That is, in contrast to the above-recited statement of the Examiner, it is not inherent that a surface of a prior art metal stent would satisfy the contact angle limitation of pending claims 1 and 18.

Notwithstanding that none of the prior art describes or suggests stent surfaces having contact angles greater than 90°, as required by pending claims 1 and 18, the Examiner attempts to dismiss this fact by yet another *unsupported* conclusion that to modify the prior art to include such a surface would involve "*routine skill* in the art" [Final Office Action, October 15, 2009, p.5, lines 3-5 (Bailey); p. 6, lines 6-8 (Momma); p. 7, lines 7-9 (Shastri); p. 8, lines 9-10 (Oktay); italics added]. However, the prior art provides no teaching or suggestion of any motivating factor that would induce one skilled in the art to make the contact angle modification suggested by the Examiner. The Examiner's conclusion is clearly an improper attempt to use hindsight and Applicants' own teaching to conjure up a feature not disclosed and not suggested by the references.

Due to the lack of a citation of a teaching for the above-discussed contact angle, functional limitation of pending claims 1 and 18, the Final Office Action does not provide a *prima facie* case to show that claims 1 and 18 are either anticipated or obvious.

Dependent claims 2 – 17 and 19 – 21 are novel and non-obvious over the art as applied in the Final Office Action, at least by virtue of their dependence on either claim 1 or claim 18.

B. Claim 18 contains additional structural and functional features that render it patentable over the art of record, Bailey in particular, as applied by the Examiner.

Independent claim 18 contains additional structural and functional features of a drug-delivery stent that independently render it patentable over the art of record, Bailey in particular, as applied by the Examiner. These features include; for example, (i) an array of pillar-like

nanostructures (claim 18, lines 22-23); (ii) dynamically controllable hydrophobicity between a first state, in which the body fluid is suspended over the top of the nanostructures, and a second state, in which the fluid penetrates the interstices of the nanostructures (claim 18, lines 24-26); (iii) a medicinal substance located in the interstices (claim 18, lines 27-28); and (iv) a control device causing the release of the medicinal substance when in the second state (claim 18, page 2, lines 1-2). This combination of features is neither taught nor suggested by the art of record. Therefore, claim 18 is patentable not only by virtue of its inclusion of a stent surface having a contact angle greater than 90°, as discussed above, but also because of the specifically-defined control of hydrophobicity, as discussed in this paragraph.

VIII. Claims Appendix

The claims under appeal are listed in Appendix VIII.

IX. Evidence Appendix

Appendix IX contains a Rule 132 Declaration of Dr. T. N. Kroupenkine. For the record, because Dr. Kroupenkine executed his declaration on July 29, 2008, he cross-references the Final Rejection of May 9, 2008 not the Final Office Action of October 15, 2008. However, the issues addressed in Dr. Kroupenkine's declaration are also raised in the latter final rejection.

X. Related Proceedings Appendix

No appendix of related proceedings is attached.

Respectfully,
Susanne Arney
Timofei Nikita Kroupenkine
Donald Weiss

By_____
Michael J. Urbano
Attorney
Reg. No. 24522
(610) 691-7710

Date: 04/24/09

Att.

APPENDIX VIII

Claims on Appeal

1. An implantable stent comprising:

a tubular member having an interior surface and an exterior surface,

at least one of said surfaces being hydrophobic to a body fluid in that the contact angle between a droplet of said fluid and said at least one surface is greater than 90°, and

a region of said at least one surface including an array of microstructures or nanostructures that covers first portions of said surface, said array causing said region to have a dynamically controllable hydrophobicity.

2. The stent of claim 1, further including a control device affixed to said tubular member for varying said hydrophobicity.

3. The stent of claim 2, wherein said control device comprises an electronic device or an optical device.

4. The stent of claim 3, wherein said control device is remotely actuatable from an external source.

5. The stent of claim 1, wherein said array leaves second portions of said surface exposed, and further including a chemically active substance adhered to at least one of said exposed second portions.

6. The stent of claim 5, wherein said substance comprises a pharmacological agent or a drug.

7. The stent of claim 6, further including a control device affixed to said tubular member, said device being capable of releasing said agent or drug from said at least one second portion.

8. The stent of claim 7, further including

an electrically conductive substrate that is configured to be electrically isolated from body fluid in contact with said array of microstructures or nanostructures, and

wherein said control device is capable of applying a voltage between said array and said substrate to vary the penetration of the interstices of said array by said fluid, thereby causing release of said agent or drug into said fluid.

9. The stent of claim 1, wherein said array leaves second portions of said surface exposed, and further including

means for electrically isolating said array into laterally separate spatial zones,

at least two of said zones containing chemically active substances adhered to the exposed second portions thereof, and

wherein said control device is capable of causing the release of said substances of the separate zones at different times.

10. The stent of claim 9, wherein said substances are the same chemically active substances of the same or a different dose.

11. The stent of claim 9, wherein said substances are different chemically active substances.

12. The stent of claim 1, further including means for altering the shape of said stent *in vivo*.

13. The stent of claim 12, wherein said altering means is capable of changing the diameter of said tubular member.

14. The stent of claim 1, wherein said tubular member has an elongated slot that is coextensive with its length, thereby forming a pair of elongated edges that are movable relative to one another, and the stent further comprising a plurality of electrically controllable structures thereon, the structures capable of moving said edges and releasably latching said edges.

15. The stent of claim 1, wherein said tubular member comprises a semiconductor substrate and said array of microstructures or nanostructures is disposed on said substrate.

16. The stent of claim 15, wherein said tubular member further comprises a layer disposed on said substrate, said substrate and said layer having different thermal expansion coefficients.

17. The stent of claim 16, wherein said microstructures or nanostructures have at least one dimension that is in the range of 4 μm to 20 nm.

18. An implantable stent comprising

a tubular member including a conducting substrate, said member having an interior surface and an exterior surface,

at least one of said surfaces being hydrophobic to a body fluid in that the contact angle between a droplet of said fluid and said at least one surface is greater than 90°, and

a region of said at least one surface including an array of pillar-like microstructures or nanostructures that covers first portions of said surface, said array rendering the region to have a dynamically controllable hydrophobicity between a first state, in which said fluid is suspended over the top of said microstructures or nanostructures, and a second state, in which said fluid penetrates the interstices of said microstructures or nanostructures,

a medicinal substance adhered to an exposed second portion of said surface located in said interstices of said microstructures or nanostructures, and

a control device affixed to said tubular member for applying a voltage between said fluid and said substrate to vary said hydrophobicity, thereby releasing said substance into said body fluid when in said second state, said device being actuatable from an *ex vivo* source.

19. The stent of claim 18, wherein

said exposed second portion includes laterally separate first and second spatial zones electrically isolated from one another, each zone containing a medicinal substance adhered thereto, and

said control device is capable of causing the separate release of said substances from the first and second zones.

20. The stent of claim 19, wherein said substances adhered to said first and second zones are the same substance of the same or a different dose.

21. The stent of claim 19, wherein said substances adhered to said first and second zones are different substances.

APPENDIX IX

Evidence

Rule 132 Declaration
of Dr. T. N. Kroupenkine

IN THE UNITED STATES
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Patent Application

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Title:	Drug Delivery Stent		

THE COMMISSIONER OF PATENTS AND TRADEMARKS
ALEXANDRIA, VA 22313-1450

SIR:

DECLARATION OF DR. THOMAS NIKITA KRUPENKIN
UNDER 37 C.F.R. § 1.132

1) I, Thomas Nikita Krupenkin (*aka* Timofei Nikita Kroupenkine), received a Ph.D. in Physics from the Case Western Reserve University in 1996. From 1998 to 2007, I was a Member of the Technical Staff at Bell Laboratories. Presently, I am a Professor with the Department of Mechanical Engineering at the University of Wisconsin-Madison.

2) My scientific research has involved primarily the interaction of solid surfaces and liquids, including the electro-wetting of nanostructured solid surfaces. The device applications of my research include, for example, optical waveguides actuated by electro-wetting, dynamically controllable biological/chemical detectors having nanostructured surfaces, electro-wetting batteries having nanostructured electrode surfaces, drug delivery stents having nanostructured surfaces for controlling

hydrophobicity, and tunable liquid microlenses. I am an author or co-author of at least 30 scientific articles and have been a contributor to scientific presentations at at least 50 scientific conventions. In addition, I am the inventor or co-inventor of at least 33 US pending patent applications and 20 issued US patents.

3) I am a co-inventor on the above-captioned patent application.

4) In preparation for this Declaration, I reviewed the above- captioned application as well as an article entitled "Wetting," which is of record in the above- captioned application and is currently available on the internet at the ***Wikipedia*** website at http://en.wikipedia.org/wiki/Wetting (hereinafter ***Wikipedia***).

5) Based on my scientific experience and education, as well as the reviews identified above, I have the following understanding of the term ***hydrophobicity***. The standard, well-known definition of ***hydrophobicity*** is correctly set forth in the above article from ***Wikipedia.*** The article begins by describing the phenomenon of ***wetting*** as the "contact between a liquid and a solid surface." From the standpoint of fundamental surface physics, the article also states correctly that the "degree of wetting is described by the contact angle" and that a "contact angle of 90° or greater generally characterizes a surface as not-wettable, and one less than 90° as wettable. In the context of water, the article states that "a wettable surface may also be termed ***hydrophilic*** and a not-wettable surface ***hydrophobic***." This statement is correct for aqueous liquids in general. Thus, the article clearly and correctly teaches that a hydrophobic surface is not wettable and, therefore, has a contact angle greater than 90° to a water droplet (Figure 1). Applicants' use of the term follows this standard definition; that is, Applicants' specification (page 5, line 21) explicitly states that a hydrophobic surface is "a low-energy surface that is characterized by a high contact angle (> 90°) to any body fluid it contacts." (This limitation is explicit in independent claims 1 and 18.) Since it is notoriously well known that body fluids, such as blood, are aqueous, it follows that the standard definition of ***hydrophobic*** is equally applicable to Applicants' invention

and is essentially identical with the explicit definition given in Applicants' specification.

6) In preparation for this Declaration, I have also reviewed the following statement made by the Examiner at page 2 (and elsewhere) of the Final Rejection of May 9, 2008: "Please note that the Examiner is interpreting hydrophobic according to a known, common definition. ***According to Dorland's Illustrated Medical Dictionary* (2003) *hydrophobic is defined as: not readily absorbing water***. Thus, since it is known metals do not absorb water, the surface of [the prior art stent] must be hydrophobic. The surface is fully capable of having hydrophobicity that has a contact angle greater than 90° when a drop of fluid contacts it." This dictionary will hereinafter be referred to as ***Dorland***.

7) Based on my scientific experience and education, as well as the reviews identified above, I conclude that ***Dorland's*** definition describes a ***necessary but not sufficient*** condition that is inherent in any hydrophobic surface; that is, the surface does not absorb water. But, the ***Dorland*** definition is incomplete because it fails to consider the critical nature of ***adsorption***, particularly in the interaction between water and a hydrophobic surface. In standard surface physics that interaction is defined in terms of the contact angle between the hydrophobic surface and a water droplet (cf., Figure 1, ***Wikipedia***). The missing aspects of the ***Dorland*** definition are particularly important because Applicants' invention is predicated on the use of a nanostructured surface to dynamically control the hydrophobicity of that surface. In one important embodiment of Applicants' invention, this dynamic control involves the application of suitable voltages to the stent, which allows a pharmacological agent or a drug to be alternately captured by or released by the nanostructured stent surface.

8) At page 8 of his Response to Arguments (Final Office action above) the Examiner asserts, without support, that Applicants have adopted a "special definition" of hydrophobic. In addition, the Examiner also asserts that "the limitation of 'a

contact angle greater than 90° when a fluid contacts the surface' is a description of the characteristics of a treated surface, it is not the definition of 'hydrophobic." To the contrary, as paragraphs (4-7) above demonstrate, Applicants' definition of hydrophobic is the ***standard*** definition well known in the physics art used to analyze the interaction between liquids and the surface of a solid. This definition, soundly based in surface physics, is applicable to the art of Applicants' invention. In contrast, ***Dorland's*** definition is incomplete.

9) Based on my scientific experience and education, as well as the reviews identified above, I further conclude that the Examiner's position on metals is also fallacious; that is, the Examiner asserts that metals don't absorb; therefore, metals must be hydrophobic. This argument contravenes the standard definition of hydrophobicity, as discussed above. Second, the prior art teaches that the contact angles of illustrative clean metal surfaces are ***hydrophilic, not hydrophobic***; that is, they have contact angles less than 90° (Au ~ 71°; Pt ~ 0°; stainless steel < 5°). Thus, the Examiner's ***unsupported assumption*** is without foundation in the art. Moreover, the further assumption that "[any metal] surface is ***fully capable*** of having a hydrophobicity that has a contact angle greater than 90°" is not supported by the prior art.

10) At page 8 of his Response to Arguments (Final Office action above) the Examiner asserts that Applicants' definition of hydrophobic "is describing a characteristic of the surface as a result of Applicants' ***process of treating the surface with a voltage***."

11) Based on my scientific experience and education, as well as the reviews identified above, I further conclude that the Examiner's assertion in paragraph (10) above, is incorrect in two respects. First, Applicants' definition does not describe a "process of treating" a surface; rather, it describes that nature of a surface in contact with an aqueous liquid. Thus, the Examiner is correct that Applicants' definition of hydrophobic describes a characteristic of a [nanostructured] surface,

but that surface is hydrophobic ***without*** the application of voltage. The role of voltage is, in one embodiment of Applicants' invention, the dynamic control of hydrophobicity. For example, application of a suitable voltage to Applicants' stent allows the hydrophobicity (contact angle) to be lowered, which in turn permits a fluid suspended across the pillars of a nanostructured surface to penetrate the interstices (i.e., the stent is loaded with a pharmaceutical agent or drug) or conversely (i.e., the agent or drug is released by the stent into a body fluid).

12) I herein certify that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I also understand that willful false statements and the like are punishable by fine, imprisonment or both under 18 U.S.C. 1001 and that willful false statements and the like may jeopardize the validity of the application-at-issue or any patent issuing thereon.

Thomas Nikita Kroupenkin, Ph.D.

Executed on 07/29/08
Date